

# Greensmith Energy Management Systems

July 27, 2011

IEEE Supersession on Energy Storage

Draft – Confidential

GS has steadily penetrated a significant number of utility and non-utility customers

	UTILITIES (8)	NON-UTILITIES
▶ Market Progress	<ul style="list-style-type: none"> <li>• Utility (2 CES systems)</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Amonix</b> (PV OEM – 1 PowerVault system for Solar)</li> </ul>
Greensmith Approach	<ul style="list-style-type: none"> <li>• <b>Utility 2</b> (10 CES systems including freq reg)</li> </ul>	<ul style="list-style-type: none"> <li>• <b>The Prosser Group</b> (Intermediary for Project/Fin'g for ConEd – 1 PowerVault system for EV charging+)</li> </ul>
Greensmith Technology	<ul style="list-style-type: none"> <li>• <b>Utility 3</b> (1 CES system for solar and EV charging)</li> </ul>	<ul style="list-style-type: none"> <li>• <b>NCSU</b> (University microgrid – 1 CES system)</li> </ul>
Trends & Implications	<ul style="list-style-type: none"> <li>• <b>Utility 4</b> (1 PowerVault system for solar +)</li> <li>• <b>Utility 5</b> (1 CES system for solar +)</li> <li>• <b>Utility 6</b> (1 CES system for residential demonstration via BP)</li> <li>• <b>Utility 7</b> (1 CES system for solar +)</li> <li>• <b>Utility 8</b> (1 PowerVault system for microgrid – Q1-12)</li> </ul>	<ul style="list-style-type: none"> <li>• <b>USF</b> (University microgrid – 1 CES system)</li> <li>• <b>EPRI</b> (Analyst/major lead source – CES and PowerVault systems)</li> <li>• <b>Boston Power</b> (Battery OEM for Duke Energy)</li> </ul>

Greensmith is in the process of expanding across multiple vectors

<p>▶ Market Progress</p> <p>Greensmith Approach</p> <p>Greensmith Technology</p> <p>Trends &amp; Implications</p>	PRODUCT/SERVICE		GEOGRAPHY	
	<ul style="list-style-type: none"> <li>• Turn-Key Systems (Sm-Med)</li> <li>• Renewables-Focused</li> <li>• MW-Level Systems</li> <li>• Frequency Regulation-Focused</li> <li>• Residential/Commercial-Focused</li> <li>• Integration Services/Contractor</li> <li>• SW Licensor/Developer</li> <li>• Data Monitoring/Management</li> </ul>		<ul style="list-style-type: none"> <li>• US</li> <li>• Canada</li> <li>• Australia</li> <li>• Israel</li> <li>• Western Europe</li> <li>• Northern Europe</li> <li>• SE Asia</li> <li>• India</li> </ul>	
	INDUSTRY		CHANNELS	
	<ul style="list-style-type: none"> <li>• Utility</li> <li>• Renewable Generation</li> <li>• Military</li> <li>• Metals/Mining</li> <li>• Home Construction</li> <li>• Commercial Construction</li> </ul>		<ul style="list-style-type: none"> <li>• Direct</li> <li>• Analysts</li> <li>• Battery or PCS OEM</li> <li>• EPC or IPP</li> <li>• Utility</li> <li>• SW OEM or Data Management</li> </ul>	

## Mass aggregation of DESS means centralized control strategy/architecture

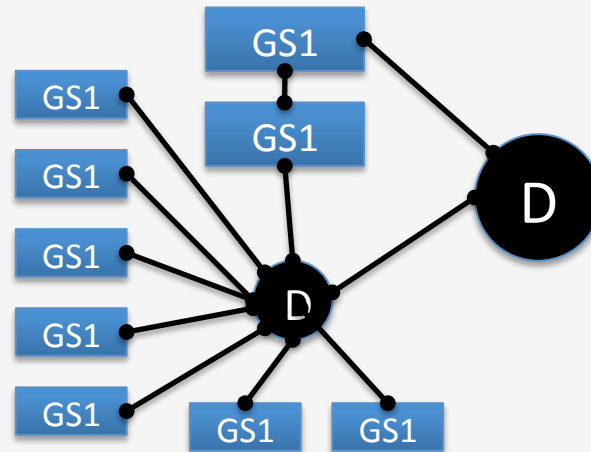
Market  
Progress

Greensmith  
Approach

Greensmith  
Technology

Trends &  
Implications

### MONDAY – AGGREGATE LOAD SHIFT



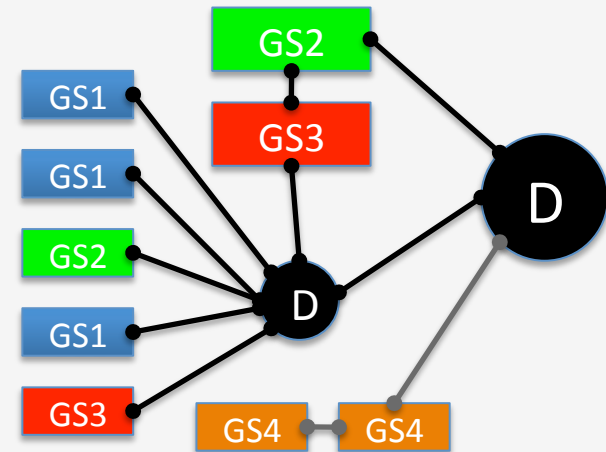
#### Use Case Scenario:

**GS1** Simple grid load shift mode

**GS1** (Larger unit)

Centralized software controls  
programmable manually  
or via automated response

### THURSDAY – TEAM ROLES



#### Use Case Scenario:

**GS1** Simple grid load shift mode

**GS2** Solar load shift mode

**GS3** Frequency regulation mode

**GS4** Mobile/dispatchable mode

*Deployment versatility allows utilities to gain significant flexibility as they build out the smart grid over time and wish to capture multiple value streams*

Greensmith started small, which required a distributed computing approach

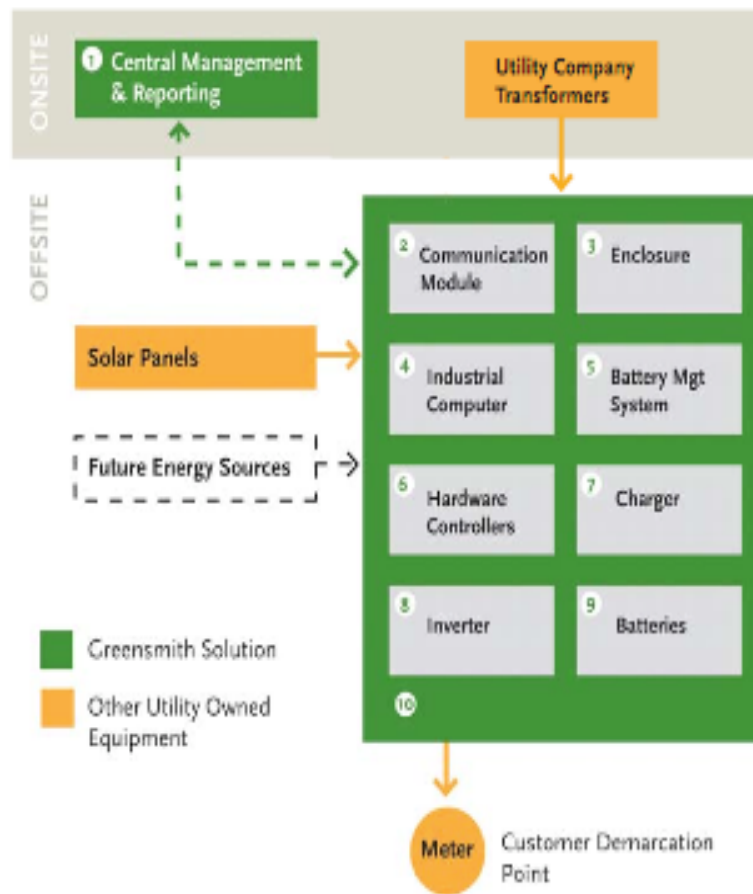
Market  
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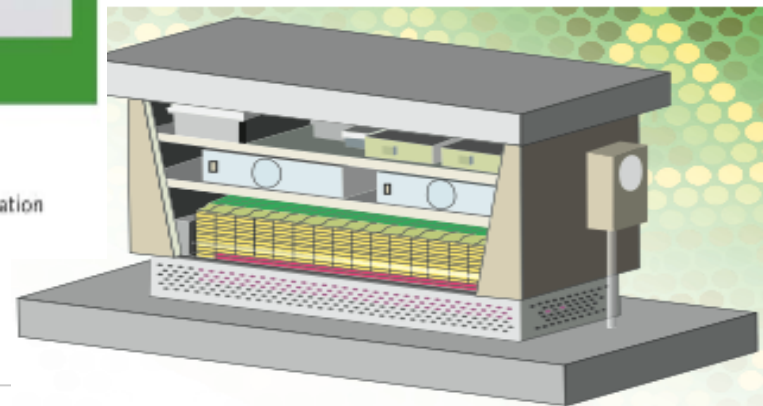
Trends &  
Implications

### Greensmith Intellectual Property Features:



### ***GS' Architecture is Capable of Multiple Applications***

- Load shifting/leveling
- Peak shaving/capacity
- Ancillary services
- Power quality
- Solar/wind smoothing
- Portable power placement



## Scalable, serviceable tray design that's battery agnostic is a key strategy

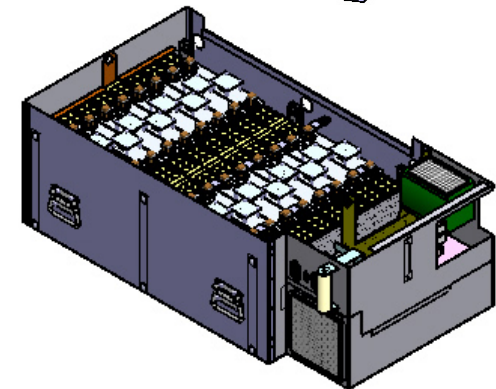
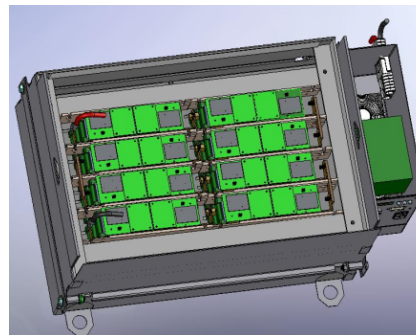
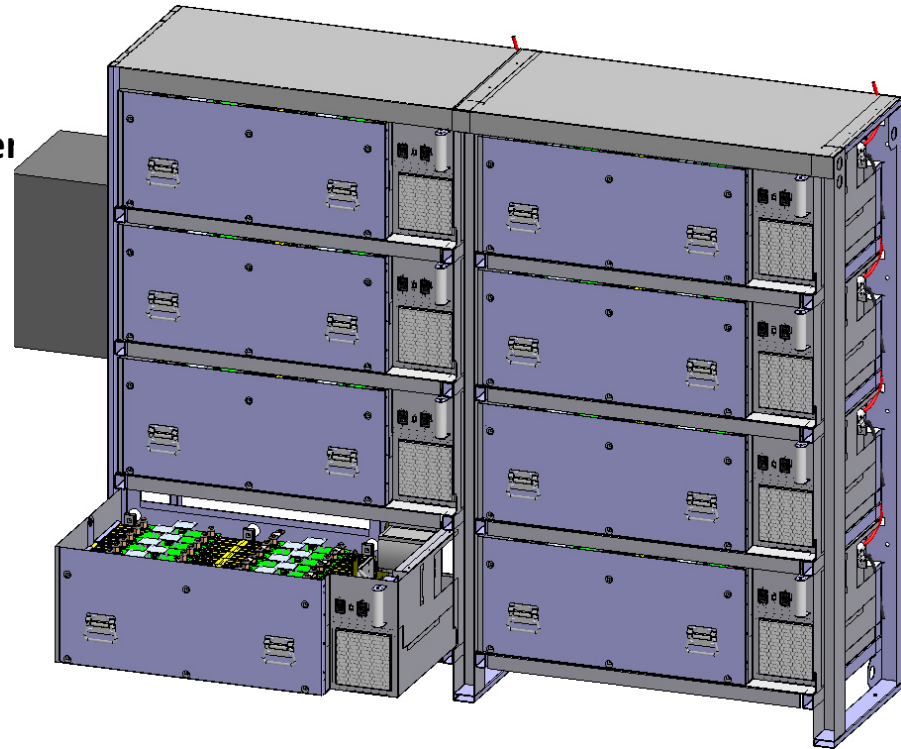
Market  
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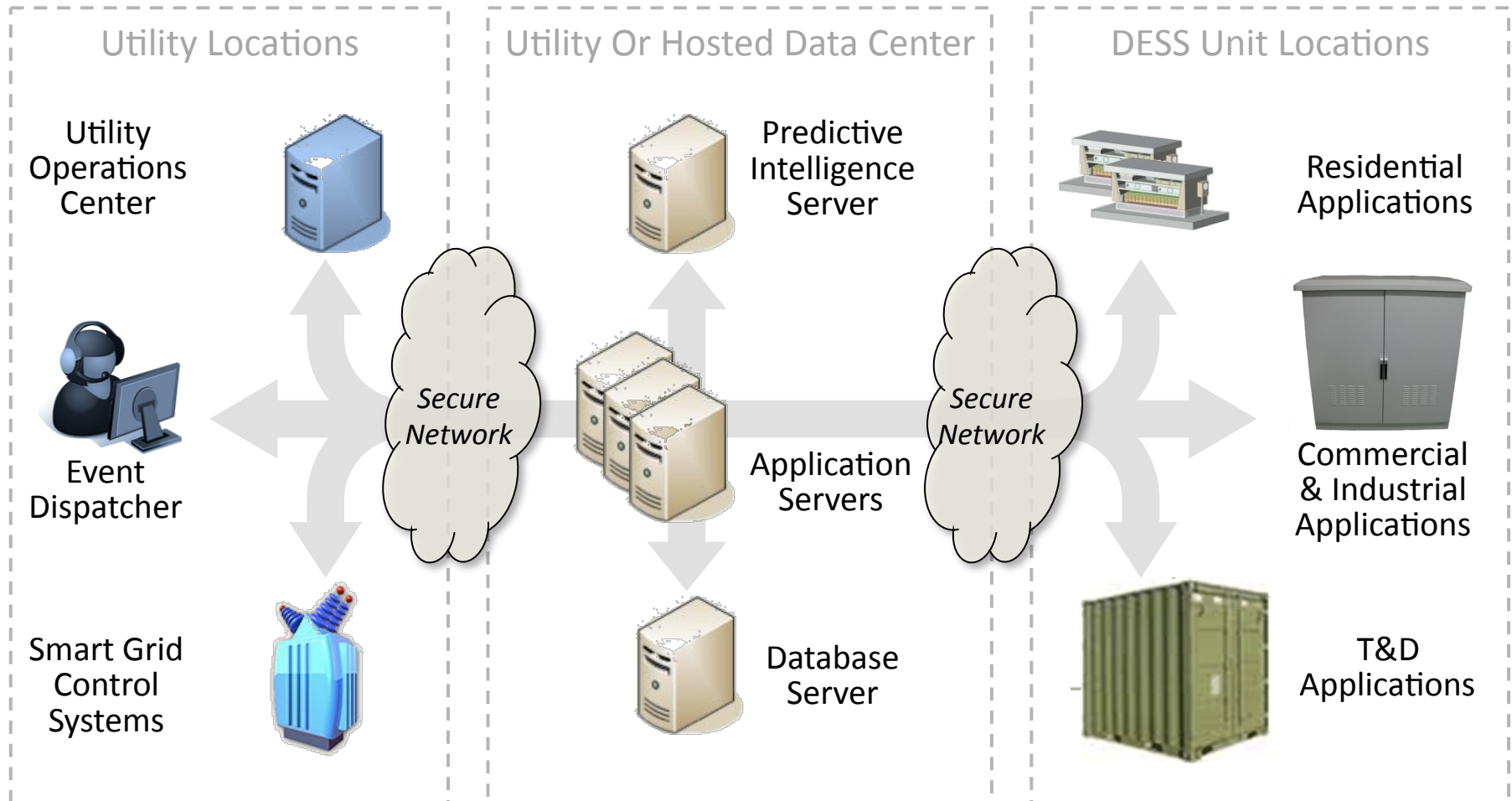
Trends &  
Implications

- **30-100 KW/25-300 KWh**
- **Support multiple battery types from multiple batter**
- **Highly modularized**
- **Pluggable battery trays for both production and off-line maintenance**
- **Stackable racks**
- **Standard Greensmith Battery OS III (BOSIII)**



# Key Features & Functions – Comprehensive

Greensmith developed a system that embraces a changing utility grid environment





# Renewable generation investment is not only a trend but a mandate

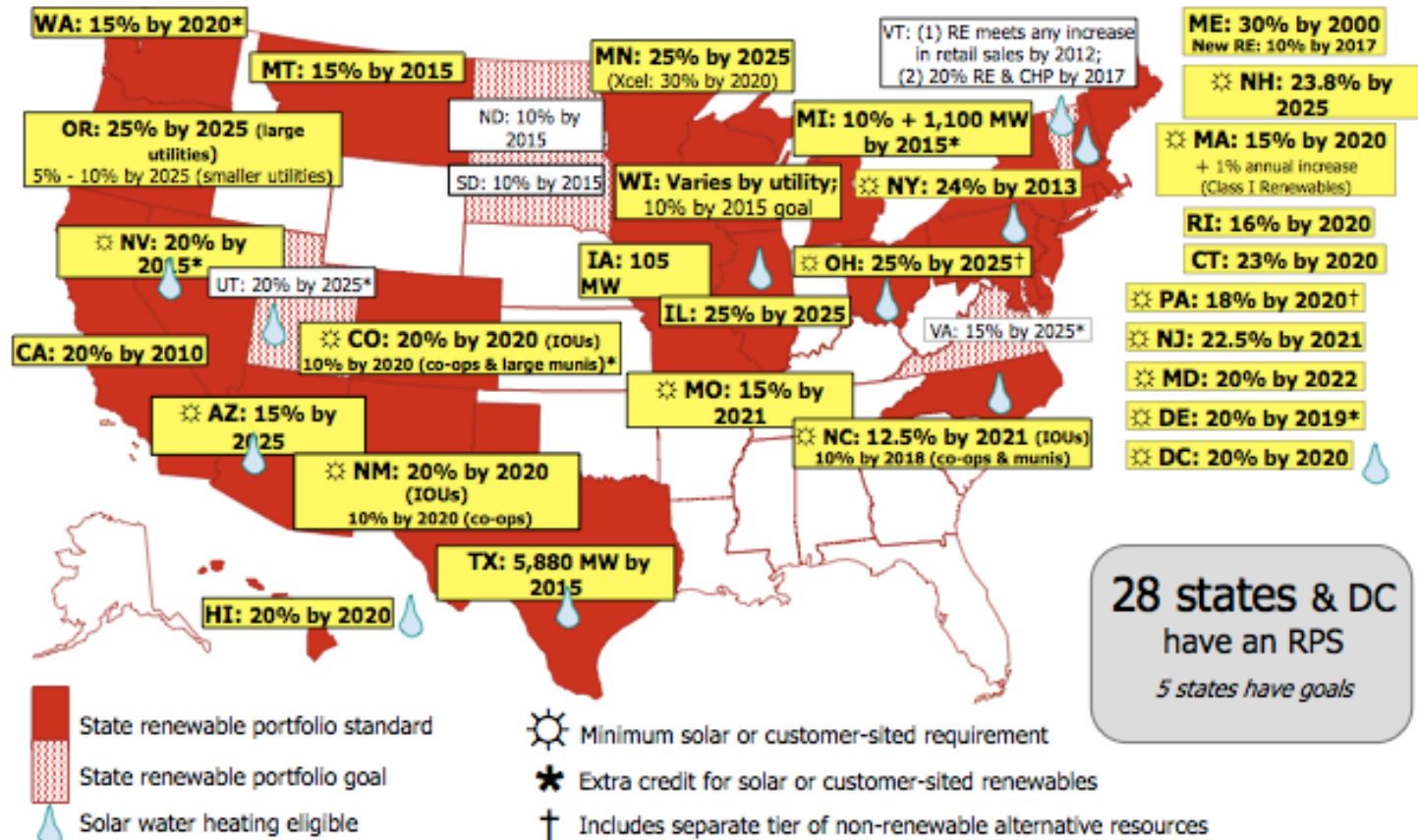
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► Trends &  
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## US RENEWABLE PORTFOLIO STANDARD (RPS)



*“When PV penetration reaches sufficiently high levels (e.g., 5 to 20% of total generation), the intermittent nature of PV can begin to have noticeable, negative effects on the entire grid” [requiring storage] - US DOE, SEGIS-ES, July 2008*



# Energy storage and cloud computing

- Multiple DESS units form virtual mega-watt storages at a various location
- When used as one virtual unit, physical units form a peer-to-peer network in a LAN
- At any LAN, a single Super Node unit take commands from Portal / Control System and operate peer units and itself in unison.
- Multiple LANs can form a even larger virtual storage units over the WAN/Internet
- Advantages:
  - High reliability – Redundancy and backups among peers in communication and control. No single point of failure
  - Energy storage on demand – physical units can be added or removed from virtual storage in response to energy or power demands
  - Versatility – At any time, multiple virtual units can be formed to perform multiple tasks (peak shaving, VAR support, frequency regulation, etc.)
  - Physical units can be distributed close to the problems

